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TRANSPERFECT | TRANSLATIONS

AFFIDAVIT OF ACCURACY

I, Joy Seletsky, hereby certify that the following is, to the best of my knowledge and belief, a true and accurate translation of the following document [Patent Application 2002-296456] from Japanese into English.

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Title of Invention: A Winding Fixing Structure of a Rotary Transformer-Type Resolver

Scope of Patent Claims

Claim 1

A winding fixing structure of a rotary transformer-type resolver characterized in that in a rotary transformer-type resolver in which an inner core equipped with flange portions at both ends of a shaft on which a rotary transformer output winding is wound and a resolver rotor on which resolver excitation windings are wound are secured to a rotary shaft so that they are aligned in the shaft direction a spacer is provided between the aforementioned inner core and the aforementioned resolver rotor, and formed in said spacer is a fixing groove into which is set a crossover that connects said rotary transformer output winding and said resolver excitation windings.

Claim 2

A winding fixing structure of a rotary transformer-type resolver described in Claim 1 characterized in that a cutout portion that draws out said crossover is formed at the flange portions formed in said inner core, and said fixing groove and cutout portion correspond in the rotary shaft direction.

Claim 3

A winding fixing structure of a rotary transformer-type resolver described in Claim 1 characterized in that a notch is formed in said rotor, and said notch and said fixing groove formed in said spacer are mutually misaligned in the circumferential direction.

Claim 4

A winding fixing structure of a rotary transformer-type resolver described in any of Claims 1 through 3 characterized in that a plurality of units of the fixing groove formed in said spacer and the cutout portion formed in said inner core are formed, and they are equivalent to each other in number.

Claim 5

A winding fixing structure of a rotary transformer-type resolver described in any of Claims 1 through 4 characterized in that the fixing grooves formed in said spacer are such that the number of grooves is equivalent to the number of windings drawn out from the rotor.

Claim 6

A winding fixing structure of a rotary transformer-type resolver described in any of Claims 1 through 5 characterized in that the fixing groove formed in said spacer is such that the outermost portion of the spacer is formed to be narrow.

Claim 7

A winding fixing structure of a rotary transformer-type resolver described in Claim 1 characterized in that said spacer is such that one flange portion formed on said inner core is used as a spacer.

Detailed Description of the Invention

(0001)

Technical Field of the Invention

The present invention relates to a winding fixing structure of a rotary transformer-type resolver and particularly to a winding fixing structure of a rotary transformer-type resolver that is ideal for securing a crossover that connects a rotary transformer output winding and resolver excitation windings.

(0002)

Prior Art

Conventionally, the following types of resolvers have been disclosed for the resolver winding fixing method. That is, among rotary transformer-type resolvers that perform AC excitation of the resolver rotor, there are resolvers in which the rotary transformer rotation side coil and resolver rotor are secured as a unit to the rotary shaft, and the rotation side coil and the resolver rotor coils are respectively bound by cord and secured by a compound (for example, see Patent Document 1). In addition, there are also resolvers in which a printed wiring board is interposed between the rotation side coil and the resolver rotor coils, the terminal of the rotation side coil is connected by solder to a through hole formed in the aforementioned printed wiring board, and the terminal of the rotor coil wound around the resolver rotor is connected to the same through hole (for example, see Patent Document 2).

(0003)

In addition, as for well-known technology, as shown in FIG. 7, there are resolvers in which a wire (hereunder referred to as a crossover) that connects the rotary transformer output winding 65 and the resolver excitation windings 64 is soldered, the crossover is covered with an insulating tube 6, and the crossover, which has been covered with said insulating tube 6, is secured to the rotary shaft 68 by means of a cord 61. The resolver shown in the aforementioned FIG. 7 adjacently provides a resolver stator 71 that has resolver stator windings 70 and an outer core 66 that has a stator transformer winding 67. A shield plate 69 that shields off leakage magnetic flux from the outer core 66 is provided in a standing manner between the resolver stator 71 and the outer core 66. In addition, a resolver rotor 63 that has resolver excitation windings 64 and an inner core 62 that has a rotary transformer output winding 65 are adjacently provided at the rotary shaft 68. The aforementioned resolver excitation windings 64 are mutually connected from the rotary transformer output winding 65 via a crossover. The respective lead wires are soldered at the crossover that is covered with an insulating tube 6, an insulating tube is put on [*sic*], and the crossover that is covered with the aforementioned insulating tube 6 is secured to the rotary shaft 68 by means of a cord 61.

(0004)

Patent Document 1

Japanese Unexamined Patent Application Publication S63-318725 (FIG. 2)

Patent Document 2

Japanese Unexamined Utility Model Application Publication H5-4427 (FIG. 1)

(0005)

Problems to be Solved by the Invention

However, in the resolver in the aforementioned Patent Document 1, treatment of the wire rod, called a crossover, between the resolver rotor coil and the rotary transformer rotation side coil is not performed, and reliability becomes a problem. In addition, in the resolver in the aforementioned Patent Document 2, the terminal of the rotation side coil

and the terminal of the rotor coil wound around the resolver rotor are directly connected to the same through hole, and the wire rod between the rotary shaft and the aforementioned through hole is at a distance. As a result, when used in a severe usage environment, such as in an automobile that has vibration, there are cases in which nonconformities occur in which the aforementioned crossover becomes loose, disconnects, shorts, or layer shorts.

(0006)

Moreover, as shown in FIG. 7, the method in which the respective lead wires are soldered at the crossover, where an insulating tube 6 is put on, and the crossover that is covered with the aforementioned insulating tube 6 is secured by means of a cord 61 to the rotary shaft, is such that, in the case where the operation of tightly binding the crossover by means of a cord 61 is performed, the space between the rotary transformer output winding 65 and the resolver rotor 63 is narrow, and time and effort are required in this operation that requires skill. The outlets of the aforementioned resolver excitation windings 64 are determined by the number of magnets, the phase of the drive voltage, etc., and when the rotor is secured to the rotary shaft 68, the outlets of the aforementioned resolver excitation windings 64 are uniquely determined with respect to the aforementioned rotary shaft 68. On the other hand, the rotary transformer output winding 65 is connected to the aforementioned resolver excitation windings 64 via a crossover 60, but if the position of the rotary transformer output winding 65 with respect to the rotary shaft 68 is not taken into account, there are cases where the distance with respect to the crossover 60 becomes farther. As a result, even if the aforementioned crossover 60 is secured by means of a cord 61, there are cases in which it may come into contact with the inner core 62, the resolver stator 71, etc., resulting in disconnections.

(0007)

The present invention was devised with the purpose of providing a winding fixing structure of a rotary transformer-type resolver that solves the relevant problems and is ideal for securing a crossover.

(0008)

<u>Means to Solve the Problems</u>

The present invention is such that, in order to achieve the aforementioned purpose, the winding fixing structure of a rotary transformer-type resolver described in Claim 1 is characterized in that, in a rotary transformer-type resolver in which an inner core equipped with flange portions at both ends of a shaft on which the rotary transformer output winding is wound and a resolver rotor on which resolver excitation windings are wound are secured to a rotary shaft so that they are aligned in the shaft direction; a spacer is provided between the aforementioned inner core and the aforementioned resolver rotor, and formed in the aforementioned spacer is a fixing groove into which is set a crossover that connects the aforementioned rotary transformer output winding and the aforementioned resolver excitation windings.

(0009)

In a winding fixing structure of a rotary transformer-type resolver described in Claim 1, the winding fixing structure of a rotary transformer-type resolver described in Claim 2 is characterized in that a cutout portion that draws out the aforementioned crossover is formed at the flange portions formed in the aforementioned inner core, and

the aforementioned fixing groove and cutout portion correspond in the rotary shaft direction.

(0010)

In a winding fixing structure of a rotary transformer-type resolver described in Claim 1, the winding fixing structure of a rotary transformer-type resolver described in Claim 3 is characterized in that a notch is formed is in the aforementioned rotor, and the aforementioned notch and the aforementioned fixing groove formed in the aforementioned spacer are mutually misaligned in the circumferential direction.

(0011)

In a winding fixing structure of a rotary transformer-type resolver described in any of Claims 1 through 3, the winding fixing structure of a rotary transformer-type resolver described in Claim 4 is characterized in that a plurality of units of the fixing groove formed in the aforementioned spacer and the cutout portion formed in the inner core are formed, and they are equivalent to each other in number.

(0012)

In a winding fixing structure of a rotary transformer-type resolver described in any of Claims 1 through 4, the winding fixing structure of a rotary transformer-type resolver described in Claim 5 is characterized in that the fixing grooves formed in the aforementioned spacer are such that the number of grooves is equivalent to the number of windings drawn out from the rotor.

(0013)

In a winding fixing structure of a rotary transformer-type resolver described in any of Claims 1 through 5, the winding fixing structure of a rotary transformer-type resolver described in Claim 6 is characterized in that the fixing grooves formed in the aforementioned spacer are such that the outermost portion of the spacer is formed to be narrow.

(0014)

In a winding fixing structure of a rotary transformer-type resolver described in Claim 1, the winding fixing structure of a rotary transformer-type resolver described in Claim 7 is characterized in that the aforementioned spacer is such that one flange portion formed on the aforementioned inner core is used as a spacer.

(0015)

Embodiments of the Invention

FIG. 1 will be used to explain an embodiment of the present invention. Note that, in FIG. 1, the crossover to be described below is not shown, and the same codes are applied to portions that are identical to those in FIG. 7. Provided within a ring-shaped case 75 is a rotary transformer consisting of a resolver portion, which consists of a resolver stator 71 and a resolver rotor 63, an inner core 62, and an outer core 66. Adjacently provided on the case 75 side are a resolver stator 71 that has resolver stator windings 70 and an outer core 66 that has a stator transformer winding 67. A shield plate 69 that shields off leakage magnetic flux from the inner core 62 is provided in a standing manner between the resolver stator 71 and the outer core 66.

(0016)

In addition, a resolver rotor 63 that has resolver excitation windings 64 and an inner core 62 that has a rotary transformer output winding 65 are adjacently provided at a rotary shaft 68, which is provided to rotate freely inside this case 75. The aforementioned

resolver stator 71, resolver rotor 63, inner core 62 and outer core 66 are all obtained by layering of silicon steel plates. Note that this outer core 66 stops at the case 75 side. The aforementioned resolver excitation windings 64 are mutually connected with the rotary transformer output winding 65, and supply of current and input and output of signals with respect to the resolver excitation windings 64 are performed via the aforementioned rotary transformer output winding 65.

(0017)

The inner core 62 and the resolver rotor 63 are engaged with a shaft holder 74 and secured to the rotary shaft 68. The rotary shaft 68 is rotatably held by a cover 73 by means of bearings 72. The cover 73 is engaged as a unit with the case 75 by bonding or screw fastening. The inner core 62 is such that in addition to the rotary transformer output winding 65 being wound on the shaft of the rotary transformer and flange portions 40, 41 being equipped at both ends of the shaft of the aforementioned rotary transformer, a cutout portion 42 (see FIG. 2) that draws out the rotary transformer output winding 65 is formed at the flange portion 41 nearest the spacer 2. A spacer 2 is provided on the same rotary shaft 68 between the inner core 62 and the resolver rotor 63. It is preferable that the aforementioned spacer 2 be a magnetic body with an effect of shielding leakage magnetic flux, but it may be another material such as a synthetic resin so long as there is no departure from the gist of the present invention.

(0018)

A fixing groove 3 that secures a crossover that is not shown in the drawing and is for connecting the aforementioned rotary transformer output winding 65 and the aforementioned resolver excitation windings 64 is formed in the spacer 2. The crossover 60 is covered with an insulating tube 6 (see FIG. 2), and it is set into the fixing groove 3. As a result, the crossover 60 that has been covered by the insulating tube 6 is secured to the spacer 2. This securing method may be such that there is impregnation and securing with varnish, etc. during varnish impregnation processing of the rotary transformer output winding 65, for example, or securing may be performed with another bonding material. The crossover 60 that has been covered with the aforementioned insulating tube 6 is secured to the rotary shaft 68, and nonconformities in which the aforementioned crossover becomes loose, disconnects, shorts, or layer shorts due to vibration and the like no longer occur.

(0019)

FIG. 2 will be used to explain the resolver winding fixing structure of the present invention. FIG. 2 is a partial enlarged drawing of the inner core 62, resolver rotor 63 and spacer 2 in FIG. 1. The rotary transformer output winding 65 is wound around the inner core 62, and it is secured by means of a cord 4 to the rotary shaft 68 along with the crossover 60 that has been covered with the aforementioned insulating tube 6. Note that the crossover 60 that has been covered with the insulating tube 6 may be secured along with the rotary transformer output winding 65 by means of varnish impregnation processing instead of using the aforementioned cord 4. The resolver excitation windings 64 are respectively wound on the plurality of rotor magnets 630 at the resolver rotor 63. Inter-magnet spaces 631 are formed between the rotor magnets 630. The inner core 62, the resolver rotor 63 and the spacer 2 are respectively secured to the rotary shaft 68. At the inner core 62, a cutout portion 42 that draws out the aforementioned crossover 60 is formed on the flange portion 41 nearest the spacer 2, and the fixing groove 3 formed on

the aforementioned spacer 2 and the cutout portion 42 correspond in the direction of the rotary shaft 68. As a result, soldering of the rotary transformer output winding 65 and the resolver excitation windings 64 becomes easy.

(0020)

The soldered aforementioned rotary transformer output winding 65 and resolver excitation windings 64 are covered with an insulating tube 6, and a crossover is formed. The crossover 60 that has been covered with the aforementioned insulating tube 6 is set into the fixing groove 3 formed on the aforementioned stator 2. The fixing groove 3 and the inter-magnet space 631 are mutually misaligned in the circumferential direction as shown in FIG. 3. That is, if the distance between the respective centers of the fixing groove 3 and the inter-magnet space 631 is considered to be d, then d > 0, and this distance d is one in which stress resulting from misalignment of the respective centers of the fixing groove 3 and the inter-magnet space 631 is applied to the insulating tube 6 that has been set into the fixing groove 3. A frictional force occurs between the insulating tube 6 and the fixing groove 3 due to the aforementioned stress. For this reason, the crossover 60 that has been covered with the insulating tube 6 is no longer horizontally misaligned and no longer falls out from the fixing groove 3.

(0021)

The shapes of the fixing groove 3 of the aforementioned spacer 2 may be those shown in FIG. 4 and FIG. 5. The fixing groove 3 may be in a direction parallel to the rotary shaft 68 (FIG. 4(a)), a direction that is inclined either way (FIG. 4(b)), or there may be a plurality thereof (FIG. 4(c)). In any case, the fixing groove 3 and the inter-magnet space 631 are mutually misaligned in the circumferential direction in the aforementioned way as shown in FIG. 3. However, in the case where there is a plurality of units of fixing grooves 3, the fixing groove 3 formed in the aforementioned spacer and the cutout portion 42 formed in the inner core are respectively equivalent in number, and one each of different resolver excitation windings 64 is set into the groove 30 and the cutout portion 42 respectively. In addition, the respective grooves 30 are misaligned in the circumferential direction with respect to the inter-magnet spaces 631. If there is a plurality of units of fixing grooves 3 in this way, the respective windings of the resolver excitation windings 64 can be set in separately. As a result, while damage, etc. resulting from contact between windings is prevented, the mutual dielectric strength is also improved. Note that in FIGS. 4, 5, and 6, the through hole shown by code 5 is a hole that engages with the rotary shaft 68.

(0022)

The cross-sectional shape of the aforementioned fixed groove 3 may be the item shown in FIG. 5. Specifically, the fixed groove 3 may be the arc shape formed at a position near the surface of the spacer 2 (FIG. 5(a)), one in which the aforementioned arc is formed inward from the surface and whose the aperture portion is formed to be narrow (FIG. 5(b)), a trapezoid (FIG. 5(c)), or a narrow square of the aperture portion. By making the aperture portion a narrow shape in this way, the insulating tube 6 no longer falls out of the fixing groove 3.

(0023)

As shown in FIG. 6, the spacer 2 may be an inner core 20 with a spacer attached in which the flange portion 41 that is nearest the spacer 2 formed in the inner core 62 is made the spacer. In relevant cases, said inner core 20 with a spacer attached is a magnetic

material in which silicon steel plates are layered, for example. That is, the thickness of the flange portion 41 is increased and made the spacer portion 401, and a fixing groove 3 is formed in the spacer portion 401 so that same action as the aforementioned spacer is performed. By sharing the spacer and the inner core in this way, while resolvers that are more compact and lower in price can be pursued, one of the flange portions 401 of the inner core 20 is such that the area that opposes the outer core 66 is increased. As a result, magnetic flux that leaks from the inner core 20 to the outer core 66 decreases, and the performance of the resolver improves.

(0024)

Effects of the Invention

Through the winding fixing structure of a rotary transformer-type resolver described in Claim 1, by providing a spacer between the inner core and the rotor and forming in the aforementioned spacer a fixing groove into which is set a crossover that connects the rotary transformer output winding and the resolver excitation windings, a crossover is secured to the fixing groove and, even in strict usage environments, nonconformities in which the aforementioned crossover becomes loose, disconnects, shorts or layer shorts no longer occur.

(0025)

Through the winding fixing structure of a rotary transformer-type resolver described in Claim 2, by making the fixing groove and the cutout portion correspond in the rotary shaft direction, soldering of the rotary transformer output winding and the resolver excitation windings becomes easy.

(0026)

Through the winding fixing structure of a rotary transformer-type resolver described in Claim 3, by mutually misaligning the aforementioned notch and fixing groove in the circumferential direction, a frictional force occurs between the insulating tube of the crossover and the fixing groove, and the insulating tube is no longer horizontally misaligned and no longer falls out from the fixing groove.

(0027)

Through the winding fixing structure of a rotary transformer-type resolver described in Claim 4 or 5, by forming a plurality of units of fixing grooves, while damage, etc. resulting from contact between windings is prevented, the mutual dielectric strength is also improved.

(0028)

Through the winding fixing structure of a rotary transformer-type resolver described in Claim 6, by making the fixing grooves such that the outermost portion of the spacer is formed to be narrow, the insulating tube no longer falls out from the fixing groove.

(0029)

Through the winding fixing structure of a rotary transformer-type resolver described in Claim 7, by making one of the flange portions formed in the inner core the spacer, while resolvers that are more compact and lower in price can be pursued, the performance of the resolver is also improved.

Brief Explanation of the Drawings

FIG. 1

FIG. 1 is a partial enlarged drawing that shows an embodiment of the winding fixing structure of the resolver of the present invention.

FIG. 2

FIG. 2 is a partial enlarged drawing that shows the winding fixing structure of the resolver of the present invention.

FIG. 3

FIG. 3 is drawing that shows the relationship between the fixing groove into which the crossover formed in the spacer of the present invention is set and the inter-magnet space of the magnets of the resolver rotor.

FIG. 4

FIG. 4 is a drawing that shows an embodiment of the fixing groove of the spacer of the present invention.

FIG. 5

FIG. 5 is a drawing that shows another embodiment of the spacer of the present invention.

FIG. 6

FIG. 6 is an oblique view of another embodiment of the spacer of the present invention.

FIG. 7

FIG. 7 is a cross-sectional view that shows a conventional resolver winding fixing method.

Explanation of Codes

2	Spacer
3	Fixing groove
4	Cord
5	Through hole
6	Insulating tube
62	Inner core
63	Resolver rotor
64	Resolver excitation winding
65	Rotary transformer output winding
66	Outer core
67	Stator transformer winding
68	Rotary shaft
69	Shield plate
70	Resolver stator winding
71	Resolver stator
75	Case

Document Name: Drawings

[see source for figures]

FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 6

FIG. 7

Document Name: Abstract

Summary

Issue: To provide a winding fixing structure of a resolver that is ideal for securing a crossover.

Resolution Means: A spacer 2 is provided between an inner core 62 and a resolver stator 63, and these are respectively attached to a rotary shaft 68. A cutout portion 42 that draws out a crossover 60 is formed at a flange portion 41 of the inner core 62, a fixing groove 3 and the cutout portion 42 correspond in the rotary shaft 68 direction. The rotary transformer output winding 65 and resolver excitation windings 64 are soldered, a wire 60 that connects both windings is covered with an insulating tube 6, and a crossover is formed. The aforementioned crossover is set into the fixing groove 3. The fixing groove 3 and the inter-magnet space 631 are mutually misaligned in the circumferential direction as shown in FIG. 3. For this reason, a frictional force occurs between the insulating tube 6 and the fixing groove 3, and securing is performed so that there is no dropping out from the fixing groove 3.

Selected Drawing: FIG. 2